THE WORK OF THE CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

BERKELEY, CALIFORNIA
MAY 1, 1952

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

THE CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

In each of its Regions the Forest Service is represented by an administrative organization for protection and management of national forests and for conduct of cooperative forestry programs with State and private agencies. There is also in each Region a forest experiment station representing the branch of research of the Forest Service. The general function of the experiment stations is to perform research and secure results leading to the solution of the various problems of wild land use and management within the Region. Much of the work of the stations is designed to assist in the solution of problems confronting national forest administration. Their work, however, is not limited to such problems but includes authority to conduct research upon any region-wide problems of this nature.

The California Forest and Range Experiment Station of the Forest Service is located in Berkeley. Under the terms of a long-standing agreement between the Forest Service and the University of California, which establishes a cooperative relationship for the Station's research program, the University provides office space on the campus for the Station. The Station is now housed most comfortably in the Forestry Building. Besides these facilities, the Station derives much benefit from its immediate contact with University specialists in the plant sciences and related fields. Portions of its program are conducted in direct cooperation with the University.

The office of the forest and range experiment station in Berkeley is the administrative headquarters for its work. Most of the actual research work is done in the field. To facilitate this work several experimental forests and experimental ranges have been established, most of them on the national forests.

The work of the Station is divided into eight functional divisions. These are: Division of Forest Economics, Division of Forest Management Research, the Forest Utilization Service, Division of Forest Genetics, Division of Forest Fire Research, Division of Range Research, Division of Forest Influences, and Division of Flood Control Surveys. The work of each of these divisions is given in general terms in the following pages.

Division of Forest Economics

The task of the Division of Forest Economics Research is to determine and appraise the physical and economic factors that influence the production and use of forest products. At present the major activity of this division at the California Station is to make the first comprehensive survey of the Region's timber resources; this job is a part of the nation-wide forest survey authorized by Congress in 1928. In California the forest survey was started in 1946. The work is organized under four sections.

An inventory section is mapping the forest areas by use of aerial photographs and compiling data on the volume, growth, and mortality of timber. Field work has been completed for the northern Coast Range and over half of the Sierra Nevada. Computation of forest area, volume, and growth have been completed for the east side of the Coast Range. Computations should be completed for the northern Coast Range in 1952. Field work will be completed in the Sierra Nevada in 1952.

Another section is responsible for determining the drain on timber resources (from logging, fire, or epidemics of disease and insects) and the probable future requirements for wood products. Several reports of lumber production have been published, but the drain and requirements work was suspended early in 1951 and the staff assigned to defense studies for NPA. The major accomplishment of this section was a survey of the equipment and manpower needs of logging and sawmilling industries in California. A survey of lumber production in the state is to be made in 1952 in cooperation with the Bureau of the Census.

When the material gathered by these two sections has been compiled, a reports section prepares the data for publication. One series of reports will present the findings on forest area and ownership for the major timber-producing counties. These reports have been issued for Siskiyou, Trinity, Mendocino, and Lake Counties. Another series will present statistics on forest areas, ownership, timber volume, growth, and drain for major timber-producing areas, and the first of these, for the Coast Range Pine Subregion, has been prepared. Special reports are published on such by-products of survey work as new volume tables, new sampling methods, or methods for estimating decay in standing trees. Survey maps of the timber stands are also prepared for publication whenever funds and manpower are available.

The fourth section of the division has been intensifying the forest survey on certain non-federal forest land in the State. This work was undertaken at the request of, and is financed by the California Department of Natural Resources. It has provided timber-stand mapping to a 10-acre minimum (rather than the 40-acre national standard), soil classification of wild land areas, and publication of detailed timber-stand and vegetation-soil maps that have proved of considerable value in managing wild lands. State funds for this project terminate at the end of fiscal year 1952, when the project is to be liquidated.

Division of Forest Management Research

California has a little more than 16 million acres of commercial forest land; approximately 8.8 million acres of old-growth timber, 4.1 million acres of cut-over land, 1.4 million acres of second-growth timber, and 2.1 million acres of once-forested brushfields. Research in the forestry problems of these areas is directed first at converting the old-growth forests to fully productive managed stands, second at improving the quantity and quality of timber growth on cut-over land and second-growth areas, and third at replacing the brush with timber stands. To do that job, research is organized in three fields: Silviculture, regeneration, and mensuration.

Silvicultural studies of the past 30 years have developed new forestry procedures designed to keep forest land continuously and adequately stocked with desirable timber species. The procedures may apply in the management of both old and young forests. The approach is new in that it requires cutting to be fitted to the natural grouping of trees within a forest type rather than to generalized rules for the type as a whole as is now the accepted practice. The procedures have been named unit area control and they are believed to give the most promise for sustained-yield management of California forests. Large-scale trials demonstrating these methods have recently been started in experimental forests of sugar pine and white fir near Pinecrest and of ponderosa pine near Susanville. Research in adapting the procedures to Douglas-fir forests in northwestern California started in 1951.

Studies of natural seeding, artificial seeding, and planting have isolated the chief obstacles to regeneration of the forest and have shown ways of getting around some of the obstacles. For example, good crops of pine seed are irregular, but logging can be timed to make the most of good seed crops. Ways of stimulating seed production are now being sought. California's dry summer climate is blamed for many planting failures, but seed-eating rodents, other wildlife, and vigorous competing brush have been found to be equally or more serious hazards. Screens, repellants, and poisons have been designed to use against rodents, and research is now trying to make them more effective and less costly. One aim of silviculture under unit area control is to give seedling trees competitive advantage over brush. And ways of circumventing the climate are being studied, such as using chemicals to retard transpiration of water by seedlings, or producing planting stock able to start growth rapidly before the soil begins to dry.

Providing foresters with the tools for determining growth and yield of timber stands is the object of mensuration work. Basic aids--volume and yield tables for the most important species, and sampling methods--have been fairly well worked out. However, as other species become commercially important, new tables or modification of existing ones are necessary. Also needed are some basic studies on growth and mortality in stands of trees.

Forest Utilization Service

The Forest Utilization Service works to stretch the timber supply by making better use of wood. In effect, this division is an arm of the U. S. Forest Products Laboratory at Madison, Wisconsin. The F.U.S. searches out the wood-using problems of the region, refers the problems to the Laboratory or other agencies for research, and brings the results to local industries, wood users and timber growers. Work at the California Station has three broad objectives.

One objective is to intensify utilization along present lines, that is, to improve sawing, nailing, and seasoning practices. For example, a new method of saw-filing developed at the Forest Products Laboratory is now undergoing field trials in California; called the Duo-kerf saw, this technique uses less power than current methods, makes a thinner saw cut, and produces smoother surfaces. Tests are being made to develop nails and nailing techniques that will reduce splitting and permit use of thinner box shook in fruit and vegetable containers. And assistance in seasoning lumber has been provided the industry through dry kiln demonstrations and field consultation.

Another objective is to broaden the utilization base by bringing heretofore little-used trees into production or by finding new uses for other species. The properties of California red fir were determined and published so that architects and builders can now specify its use with accuracy. Similar studies are being made for Douglas-fir from the Coast Range forests, where timber cutting has only recently started. Tests have shown that veneer can be successfully cut and dried from white fir, California red fir, and local hardwoods. Cutting, drying, and gluing of redwood veneer are being studied. Kiln-drying methods were developed for California black oak, opening the way for manufacture of lumber from a local hardwood that has been neglected because it was thought impossible to season.

The third objective is to find uses for logging and milling leftovers which are now being wasted. A wide variety of wood-fiber and chemical utilization methods is being studied by the Forest Products Laboratory and other agencies. Methods have been devised to make molasses and yeast for stock food and alcohol for industrial use from sawdust and wood chips. Fiberboard processes that use little water have been developed, and pulping processes worked out for hardwoods not previously pulped. Ways have been found to make heavy timbers or large panels from smaller sizes of lumber. New plastic materials and anti-shrink treatments for wood have been developed. Some of these utilization methods are in commercial production, some ready for pilot-plant testing, others are still experimental. Their application in California can bring new industries to the State and increase employment in forest industries already here.

Division of Forest Genetics Research

Forest genetics research seeks to increase forest productivity by developing superior timber trees. The same techniques are used as have been applied successfully to many farm crops, the objective in forestry being to develop trees with faster growth, better form, better wood quality, or greater resistance to insects and disease than the trees foresters now are harvesting. Most of this division's work is done at the branch station, near Placerville, called the Institute of Forest Genetics.

The Institute has the most complete arboretum of pine species in existence and is conducting research aimed at improving pines throughout the United States. The work can be grouped under three headings--pine breeding, field application, and fundamental studies.

Pine-breeding work includes both selection of trees with superior growth habits and hybridization by means of controlled pollination techniques developed at the Institute. So far 70 hybrid combinations have been produced; many of them exhibit faster growth or better form than one or both of their natural parents. Another kind of work may have even greater importance than improving the growth rate of pines. This includes two cooperative programs of research, one to develop white and sugar pines resistant to the blister rust disease, another to develop pines resistant to bark beetles. Both these forest pests cause tremendous losses of timber each year. Preliminary tests with certain white pine hybrids have shown them to be resistant to blister rust, and a few wild trees that have exhibited resistance are being selected and grafted for production of seed orchards. The idea of developing pines resistant to bark beetles is an outgrowth of tests which showed one hybrid is resistant to the pine reproduction weevil, which has destroyed several young plantations in California.

To speed application of the results of research, field plantings of hybrid seedlings are being made in the United States and abroad, in cooperation with many agencies, timber companies, and research workers. Experimental seed orchards have been established at the Institute to increase production of hybrid seed. Foresters from other agencies in several regions of the country and from foreign countries are being trained in the techniques of tree breeding.

Fundamental studies supply valuable clues to increase the effectiveness of pine breeding. Chemical analyses of pine turpentines for example, suggest the relationship of various species and in this way guide the crossing program. Other studies are made to improve pollen storage, induce flowering, or find techniques for grafting and rooting pine shoots.

Division of Forest Fire Research

The Forest Fire Research Division is charged with the task of developing information that will reduce the cost of fire control and the damages caused by fire. California is one of the most critical fire areas in the country because of its inflammable vegetation, long rainless summers, and high incidence of man-caused fires. The State spends about $9,000,000 yearly, and the U. S. Forest Service about $4,500,000 on fire protection. Research aimed at reducing this bill is divided into three principal fields.

The first is the study of fire behavior--the way forest fires start and spread. This includes laboratory experiments in the physics and chemistry of wood combustion, field tests with small fires in different natural fuels and burning conditions, and field observation of large forest fires. Knowledge gained in the study of how fires ignite and spread has made possible development of a fire-danger rating system for the California region. This system shows fire control managers the current potential fire-fighting job load. Fire behavior knowledge is also essential to the effective planning of strategy and tactics for the fire-fighting job. Continuing studies are adding to this knowledge.

The second field of research, fire control, might be considered an extension of the first field; that is, it includes finding ways to apply fire-behavior knowledge to prevent or control fires. For example, the organization of large fire-fighting forces is being studied to find more effective ways of using manpower when burning conditions are extreme. More effective methods for prevention and control of fires are being sought, too. For example, chemical treatments have been devised to clear firebreaks and reduce roadside fire hazards. Tests of wetting agents and other chemicals have been made in a continuing search for improvements over water alone for fire fighting. Field tests with fire crews have shown the need for improving methods of applying water on fires. Study is being made of how to do it. Of course, better knowledge of fire behavior and control is extremely useful in improving the technique of using fire itself as a land-management tool.

The third field is study of the benefits and damages that result from fire. This research can be illustrated by a fire damage appraisal for the four southern national forests. It was found that fires can increase flood peaks by 2 to 30 times and erosion by 35 times, and that damages from increased runoff and erosion range from a few cents to more than $800 per acre of watershed burned. By using the results of this study, fire-fighting forces and strategy can be planned to give the best protection in high-damage areas. A similar study is progressing for the northern California national forests, where appraisal is more difficult because wild land resources are subject to a wider variety of uses. An early finding is that salvage logging after fire may lead to high erosion rates on critical areas.

Division of Range Research

The job of range research is to develop information on how the State's 37 million acres of range land should be grazed to contribute most to the livestock industry and the general public. This job is subdivided into four main lines of study: management of the mountain ranges in northeastern California, management of the foothill ranges of the San Joaquin basin, range reseeding, and brushland improvement.

Mountain-range management is being studied mainly at the Burgess Spring Experimental Range on the Lassen National Forest. This area is typical of summer cattle ranges with perennial-plant vegetation. Grazing capacity is about half of what the land is capable of producing. Research completed in 1950 has shown the way to arrest deterioration of the range and make the land fully productive. A plan of management that will accomplish these ends has been formulated, and work is under way to test and demonstrate the plan on an entire national-forest range allotment.

Foothill-range management is studied from the San Joaquin Experimental Range, in Madera County, in cooperation with the University of California. Research completed in 1948 showed how to use the annual-plant range vegetation efficiently and maintain both good livestock production and satisfactory range conditions. In the next phase of the study, research is being aimed at improving forage production through cultural practices, such as fertilization, brush removal, and rodent control.

Reseeding studies are conducted in both the mountain and foothill areas, but most of the work is concentrated in sagebrush ranges of northeastern California. Research has shown that successful reseeding can increase the amount of forage and lengthen the grazing season. To develop successful practices for California, the studies are seeking answers to these questions: What grasses should be used on different range sites? Where is reseeding most likely to pay? How should the seed be planted? Can production be increased by improved forage plants developed through plant breeding? Finally there is the question of how seeded areas should be managed to insure sustained high production of forage (an exceedingly important study yet to be started).

Brushland-improvement studies, which started in 1949 in cooperation with several state agencies, are seeking economical methods of converting brush-covered ranges to more productive types of vegetation. So far, tests of reseeding have been started in 10 counties, to determine how well the sown grasses will prevent erosion, reduce the growth of brush, and produce forage. Techniques to make controlled burning safer and more effective are also being studied.

Division of Forest Influences Research

Forest influences research in California is research in the management of wild land watersheds. Its chief problems are too little clear, usable water to satisfy local demands; paradoxically, too much or too early delivery of water at times; and too much erosion.

The first point of attack on these problems is to understand how a watershed functions--the "how" and the "how much" of water and soil movement as influenced by watershed conditions, such as topography, geology, soil and vegetation. Study of these processes is concentrated on the San Dimas Experimental Forest and Los Angeles River watershed in southern California. Both areas are situated in chaparral or brush cover of the San Gabriel Mountains, where water-supply, flood, and erosion problems are very acute. Other studies have been conducted in ponderosa pine and woodland-shrub areas of the central Sierra Nevada. Much research effort has gone into developing instruments and experimental techniques for measuring soil and water movement, and into accumulation of basic data. These data are being analyzed for publication.

The second step is to develop methods of watershed management which will assure the maximum yield of usable water with satisfactory regulation of flood runoff and erosion. This embraces three fields of research, namely, in damaged watersheds, in resource use, and in watershed improvement. Studies in damaged watersheds concern how the damage affects runoff and erosion, what is the natural course of recovery from damage, and how runoff and erosion can be reduced during the recovery period. This work has included a study, jointly with the Division of Forest Fire Research, of fire damage on the four southern national forests. Recovery of natural vegetation after fire and the growth of grasses and herbs sown on burned areas are under study in southern California. A study of erosion-control methods in the smelter-fume-denuded area at Shasta Lake was completed in 1951 and recommendations made for further control work.

Since the mountain watersheds produce timber and forage as well as water, and contain roads, dams, and other engineering works, research is conducted in the use of these resources and how their development may affect water and soil. The aim of the work is to recommend logging, grazing, and engineering practices that will cause a minimum of watershed damage. Methods of controlling erosion on mountain roads have been worked out, and field studies are being made of grazing practices and gully-control measures in mountain meadows, and of brushland improvement practices. Study of logging practices is planned.

Finally, ways are being sought to improve on nature by management or change of vegetation and by use of engineering methods. This field of research seeks greater water yields, lower flood peaks, cleaner water, and more timely stream flow than can be had from natural, undamaged watersheds. This work has been most active in southern California, some studies being aimed at changing the plant cover so as to better stabilize the soil on steep slopes, others at reducing evaporation losses of water. Research in methods of controlling the water yield from commercial forest, initiated in the Kings River drainage, has been inactive since the war. Studies in alpine snow areas are yet to be started.

Division of Flood Control Surveys

Flood control surveys are made at the direction of Congress to carry out the U. S. Department of Agriculture's responsibilities under the Flood Control Act of 1936. Their purpose is to develop forest, range, and cropland programs that will reduce runoff and erosion on upstream portions of watersheds. The programs complement downstream flood-control projects of the Corps of Engineers and the Bureau of Reclamation.

The Department of Agriculture work is done by the Forest Service, through its regional experiment stations, and the Soil Conservation Service. These two agencies work together in investigating flood-control problems and developing remedial programs, one or the other agency being given primary responsibility for preparing the final report on each watershed. Developing feasible programs is dependent to a large degree on the research findings of other Station divisions, which provide the cause and effect answers needed to evaluate remedial measures. Before the report is transmitted to Congress, it is reviewed by regional offices of other interested Federal agencies, by agencies of the State of California, and by the people of the survey area.

In California this Station has surveyed nine watersheds: Santa Maria, San Gabriel, Santa Ana, Santa Clara, Ventura, Los Angeles, and Santa Ynez Rivers, Wrightwood tributary of Mojave River, and western San Diego County. The Station has assisted the Soil Conservation Service on the Pajaro, Salinas and Russian River surveys. The Los Angeles and Santa Ynez surveys have been completed, and Congress has authorized the remedial programs. Congress has authorized surveys for practically all streams in California, and preliminary examinations have been completed on about 85 percent of them.

This Station is also assisting in the development of flood-control plans for the Columbia River Basin, where it has been assigned the watersheds of Willamette, Rogue, and Umpqua Rivers, and the Harney Lakes Basin in Oregon; and the Lewis and Cowlitz Rivers in Washington.

The remedial measures proposed by these surveys vary from watershed to watershed. They may include intensified fire protection, improved grazing and logging practices, reforestation, range reseeding, or a number of conservation farming practices. Check dams, tributary channel structures, road slope stabilization, and other minor engineering works may be required. The aim always is to hold back the water and stabilize the soil in the upstream areas where floods originate, and, for a program to be recommended to Congress, this aim must be achieved at a cost less than the benefits from the program.

Branch Stations

There follows a brief description of each of the active field branches of the Experiment Station; these branches serve as outdoor laboratories for the research divisions. Several other experimental areas are held in reserve for research work but at present have no active programs under way.

Big Creek Watersheds

Location.--In the Sierra National Forest within the Kings River drainage, 43 miles northeast of Fresno. Directions to the area can be obtained at the Forest Supervisor's office at North Fork, Madera County.

Size and Type.--Seven small watersheds covering 200 acres in woodland-grass type with range in elevation from 1,000 to 2,150 feet.

Kinds of Studies.--Effect of changes in vegetation upon water yield, flood runoff, and erosion.

Blacks Mountain Experimental Forest

Location.--About 35 miles north of Westwood on the Westwood-Pittville highway. The experimental forest is in the Lassen National Forest, and detailed directions can be obtained at the Forest Supervisor's office in Susanville.

Size and Type.--9,000 acres, representative of ponderosa and Jeffrey pine forests in California's northeastern plateau.

Kinds of Studies.--(1) Experimental logging to test and demonstrate the practical value of forest-management methods developed by previous research. (2) Methods of reducing tree mortality due to insect attack, in cooperation with the Bureau of Entomology and Plant Quarantine. (3) Methods of cutting old-growth pine forests. (4) Plot studies of tree reproduction and growth. (5) Improvement of pine stands by thinning and pruning.

Burgess Spring Experimental Range

Location.--In the Lassen National Forest about 12 miles east of the headquarters of Blacks Mountain Experimental Forest.

Size and Type.--750 acres, representing mountain summer ranges of two types: Cut-over pine timber and intermingled meadows, both having perennial-plant forage.

Kinds of Studies.--(1) Grazing habits and weight trends of cattle in both cut-over pine and meadow types. (2) Growth and yield of forage plants. (3) Effect of stocking rate and of season, frequency, and distribution of grazing on forage and livestock production. (4) Methods of eliminating undesirable plants. (5) Range reseeding.

Feather River Experimental Forest

Location.--In Plumas National Forest, 4 miles north of Quincy on State Highway 24.

Size and Type.--4,000 acres, representative of the western Sierra Nevada forests having a mixture of five coniferous timber species.

Kinds of Studies.--(1) Methods of producing and grading trees for forest planting. (2) Improving growth and quality of forest stands by thinning. (3) Ecology and control of forest rodents, in cooperation with University of California. (4) Plantings of pine hybrids.

Institute of Forest Genetics

Location.--In Eldorado County, 4½ miles east of Placerville via U. S. Highway 50.

Size and Type.--106 acres, with soil and climate especially favorable for tree-breeding work.

Kinds of Studies.--(1) Genetic relationship of pine trees. (2) Hybridization of pine trees. (3) Selection of superior trees. (4) Propagation of trees by cuttings and grafting. (5) Resistance of pines and hybrids to insect attack, in cooperation with Bureau of Entomology and Plant Quarantine. (6) Resistance of pines and hybrids to white-pine blister rust disease, in cooperation with the Office of Blister Rust Control and other agencies. (7) Mass production of hybrid seed.

San Dimas Experimental Forest

Location.--In the Angeles National Forest; headquarters in Glendora, 17 miles east of Pasadena via U. S. Highway 66; the experimental forest is north of Glendora in the watersheds of Big Dalton and San Dimas Creeks.

Size and Type.--17,000 acres, representative of the chaparral-covered mountains of southern California.

Kinds of Studies.--(1) Measurement and evaluation of precipitation, stream flow, and evaporative water losses on experimental watersheds. (2) Effects of changes in vegetation on stream flow, erosion, and water yield. (3) Methods of stabilizing the soil on steep mountain slopes. (4) Effects of forest fire on floods and erosion. (5) Methods of repairing damage to chaparral watersheds.

San Joaquin Experimental Range

Location.--In Madera County, about 22 miles north of Fresno on State Highway 41.

Size and Type.--4,600 acres of the annual-plant ranges of the Sierra Nevada foothills.

Kinds of Studies.--(1) Effect of range fertilization on forage growth and yield, grazing habits of cattle, and weight gains of cattle. In cooperation with the University of California (2) Range improvement by removal of brush; (3) cattle herd improvement; (4) livestock nutrition; (5) forage consumption by range rodents.

Shasta Experimental Forest

Location.--In the Shasta National Forest; experimental work conducted from two headquarters--one in Mt. Shasta, the other at Pilgrim Creek, east of McCloud.

Size and Type.--Entire east half of Shasta National Forest, representing a wide variety of vegetation and topography.

Kinds of Studies.--(1) Relation of fundamental principles of combustion to forest fuels and environmental conditions. (2) Speed and strength of initial attack by fire-fighting forces. (3) Manpower, equipment, and techniques needed for efficient fire control. (4) Organization of fire-fighting forces. (5) Pilot tests of these studies as basis for recommending new or improved techniques.

Stanislaus Experimental Forest

Location.--In the Stanislaus National Forest, 30 miles east of Sonora via State Highway 108. Detailed directions can be obtained at Pinecrest Ranger Station.

Size and Type.--Two separate tracts, totaling 1,500 acres and representing the mixed-conifer forest of high site quality for sugar pine.

Kinds of Studies.--(1) Silvical studies to determine growth requirements of the tree species. (2) Direct seeding and planting trials. (3) Thinning experiment to favor sugar pine. (4) Demonstration of unit area control. (5) Plot studies of tree reproduction and growth. (6) Plantings of hybrid pines.